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Failure to launch: the technical, ethical and legal case against Mars One

Michael Listner & Christopher J. Newman

Introduction

The Mars One Project is the brainchild of Dutch entrepreneur Bas Landsdorf. The proposition is seemingly a simple one: select a team of four volunteers to establish a permanently colony on Mars with a launch date of 2023. Given that this will be, according to Landsdorf “the media event of the century”, the \$6 billion venture will be funded by a reality TV show and subsequent media sponsorship. Undoubtedly, Mars One has captured the zeitgeist with disproportionately optimistic media coverage heralding the selection of a group of hopeful colonists. Yet, significant criticisms and troubling questions encircle the project. This piece will examine those questions and criticisms and provide a sobering evaluation of some of the technical, legal and ethical challenges facing Mars One. This article is not intended to be an exhaustive examination of all the technical, ethical, legal and political issues facing this venture. Rather it is intended to be a précis of some of the issues that need to be addressed by the Mars One Project if it to meet its deadline and its goals..

At the outset, there are two important and interlinked caveats that preface this discussion. First, it should be noted many of the problems facing the Mars One project are not *sui generis* to this endeavour. Any crewed mission to Mars will face them. The issue is not that such problems are insurmountable; merely that Mars One does not have the capacity or the budget for the research and development necessary to overcome them. Second, and perhaps crucially, this is not an attack on the people involved in the project. There is much to admire in the pioneering spirit and genuine enthusiasm held by those involved. This discussion is not seeking to discredit or diminish their bold vision. It is the project itself that is under scrutiny, a project that, it is submitted, poses significant risk to these participants.

Clutching at Straws: The illusion of existing technology

Whilst the ethical and legal challenges are considerable it is first necessary to acknowledge that this is a venture that will ultimately rise or fall on the technical and engineering elements. The stated aim of the Mars One project, according to their website is to use 'existing technologies available from proven suppliers.'² This statement provides the first crucial difficulty. At each crucial phase of the mission: travel to Mars, landing and establishing a permanent colony, the claim that of utilizing existing technology is unsustainable. At present the only existing technology that is currently operational in respect of human spaceflight is the Russian Soyuz capsule. Mars One states that the existing technology that will be used to traverse the 34 million miles from the Earth to Mars will be a variant of the Space X Dragon Capsule. To badge the considerable research and development that this would

require as 'existing technology' is, at best grossly oversimplifying the issue.

There has been no clear articulation of how the Dragon capsule will be uprated for human spaceflight nor how far along Space X is with the creation of a habitable crew module. The Mars One project provides no detail in respect of the development of reliable and effective life support systems and the problematic subject of dealing with human waste disposal. These are issues that will ultimately need solving for a successful mission to Mars, and there is significant research and development activity ongoing in this area.³ Such technology is, however, by no means 'existing' without a significant amount of investment in research and development to operationalize it.

The picture is very much the same when considering the critical issue of landing the Mars One colonists on the Martian surface. Identified as one of the most problematic aspects of human exploration, it is this aspect of the Mars One project where the notion of using existing technology is exposed as being dangerously misleading. The existing technology that has landed rovers on Mars will not be suitable for landing humans.⁴ The Martian atmosphere poses considerable and serious challenges for landing a heavy payload onto the surface. The atmosphere varies considerably in both thinness and pressure making it extremely difficult to upscale existing technology used to land small rovers. Supersonic retro-propulsion, which at present seems the most promising method of overcoming the obstacles posed by the variable Martian atmosphere, remains in the realm of untested theory, requiring expensive research and

development.⁵ Again, this is not a problem unique to the Mars One project. It is, however, a fundamental obstacle to a 2023 mission with a projected budget of \$6 billion.

Assuming, however, that the colonists from Mars One actually make it to the Martian surface, one aspect of space technology that remains untested, and makes the Mars One project fundamentally different from any previous space activity, is the technology required for the colonization of Mars. Much has been made of the In-situ Resource Utilization (ISRU) techniques that will enable the colonists to live off the land. The much-publicized MIT feasibility study of Mars One casts significant doubt on the readiness of ISRU technology, none of which has been deployed in practice.⁶ When challenged on this, the Mars One team responded by maintaining that the MIT study was based on ISS operations and therefore the study does not provide a valid comparison.⁷

Such assertions are, however, inconsistent with the stated aim of using existing technology. Either Mars One will utilize existing technology that has been tested in space on the ISS (in which case the MIT study is valid), or they will be looking to extrapolate new, untested methods of ISRU, which raises questions of reliability and cost in terms of money and time. In any event, the MIT study did not consider issues such as establishing a reliable power system, establishing a reliable communications network and the costly issue of space suit and habitat development all of which raise further questions about the technical feasibility of the entire venture. The funding model for the Mars One project has already been criticized as being flawed.⁸ A trip to Mars is not simply 'Apollo with bigger rockets'⁹ and on a crude costing basis,

the Apollo program cost the equivalent of \$100 billion¹⁰. What the Apollo program did demonstrate unequivocally was that pioneering developmental space exploration almost invariably exceeds even the most generous budgetary estimates. Simply put, the figures do not suggest Mars One has anywhere near the requisite resource base to accomplish even the most fundamental research and development required for an undertaking of this nature.

The Ethical Vacuum: Mars One, Psychology and Experimentation

There is, therefore, a formidable technical deficit in respect of a crewed mission to Mars. There is also, perhaps more significantly, a deficit in understanding the human dynamic of a one way trip to Mars. This has been identified by a number of different observers as posing a danger to the crew that is every bit as deadly as the lack of testing of ISRU materials and the significant questions in respect of landing a crewed module.¹¹ Psychologists have already highlighted serious threats to mental health such as social isolation, confinement and lack of direct access to mental health services.¹² Unfortunately, the funding model of Mars One actually serves to exacerbate these difficulties by adding a loss of privacy to the already potent mix. The Russian Mars 500 experiment clearly established that there was a threat to mental health from prolonged space travel.¹³ The question this naturally begs is to the effect that the constant surveillance imposed by reality TV will have and how such mental health issues will be dealt with.

Such issues point to three fundamental ethical difficulties. First, it is unclear how a crewmember suffering a severe mental health issue

will be dealt with in respect of privacy. Reality TV demands spectacle and sponsors who are paying large sums will be dependent on incident once the drama of launch and landing has abated. The humane and ethical course of action would be to suspend TV coverage whilst the psychological support team tried to manage the incident, but TV executives, hungry for spectacle may well be tempted to exploit this situation. Will counseling sessions be conducted in the gaze of TV audiences? The impact of such fundamental invasion of privacy, under the most extreme and trying conditions is simply not understood. There has been no clear and detailed plan articulating the way in which the mental health of the colonists will be monitored.

The necessary psychological interventions described above will be made substantially more difficult as it is not in real time, given the communications delay. The Mars One project website has a FAQ site which specifically deals with health and ethics, but there is no specific information provided on what will be televised and what will not.¹⁴ Simply reiterating that the potential colonists are 'living their dream' is no substitute for a robust consideration of the significant threats posed to the mental health of those who volunteer for Mars One. This ethical concern gives rise to a fundamental issue of liability for the welfare of the colonists and the conditions in which they will live. Psychologist Chris Chalmers highlights this fundamental flaw in the project:

"The notion that "attitude" will somehow inoculate the colonists against these conditions is at best naive, at worst irresponsible. How will the Mars One programme react when a colonist who was deemed psychologically fit suffers a major breakdown after years

of isolation, with no way to get home? Who will be responsible then?”¹⁵

The second significant ethical difficulty is linked in to the wider issue of the health of the participants. The issues in respect of access to mental health services are equally as applicable in respect of serious physical illnesses. Whilst the colonists may be given medical training, there are some illnesses, such as the treatment of cancer, which remain the purview of specialists. In a Q & A for the Guardian, when asked what happens if the colonists become ill, Bas Lansdorp stated the exact details are still to be determined.¹⁶ Given that both the mental and physical health of a small group are a crucial aspect of the success of the mission, this lack of detail – a feature that runs throughout the entire project – must raise questions about the liability of parties on Earth for injury caused to any of the colonists.

The third, and broader issue in relation to the ethics of the mission is the extent to which the Mars One project has the right to establish a permanent colony on Mars. The Mars One website makes regular references to the exploration of Columbus and Shackleton. Alluding to these colonial ventures, designed to expand the resource base of their respective empires serves only to highlight the irrevocable nature of the human colonization of Mars. The Martian biosphere is unique and largely free from human interference. A crewed base on Mars would alter the distinct biological characteristics of the environment. Human activity inevitably creates waste, even with recycling; there will be a human impact upon this alien environment. While there may be compelling arguments as to why Mars is ideal for

human colonization, there is no evidence that this Mars One project has received any independent, rigorous ethical scrutiny.

Colonization: the colonial legacy and customary international law

Aside from the technical and ethical questions raised by Mars One, there are substantial legal and political questions that will have to be overcome. The colonial issue, mentioned above, of itself raises significant legal and political questions. The Netherlands and the United States, to the extent that Mars One incorporates and becomes subject to the jurisdiction of the United States, have less than spotless histories with regards to colonization. The first question to ask is whether Mars One could become a colony in the historical and legal sense.

A colony is [a] dependent political community, consisting of a number of citizens of the same country who have emigrated there from to people another, and remain subject to the mother-country. It is a settlement in a foreign country possessed and cultivated, either wholly or partially, by immigrants and their descendants, who have a political connection with and subordination to the mother-country, whence they emigrated. In other words, it is a place peopled from some more ancient city or country.¹⁷

At first blush, it may seem that that traditional legal and political concept of a colony does not apply simply because the potential colonists will come from several countries. In fact, the argument will likely be made by private space advocates that the "colonists" who

come from several countries will not be colonists in the traditional sense because Mars One is a private venture and will not be subject to the jurisdiction of any terrestrial government. However, the current body of international space law invalidates that belief. Specifically, Article VI of the Outer Space Treaty states:

“States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization.”

This means that Mars One as a non-governmental entity incorporated as a non-profit in the Netherlands is subject to the continuing jurisdiction of the Netherlands. Moreover, when and if Mars One incorporates as a non-profit in the United States, it too would be subject to the continuing jurisdiction of the United States.¹⁸ Mars One and its colonists would be considered non-governmental entities. They would remain under the jurisdiction of both the Netherlands and the

United States government per Article VI, which in effect would make both nations their "mother country" and hence make the settlement a colony of both nations.¹⁹ Since Mars One will be considered a colony of both the Netherlands and the United States, the next question is whether either country wishes to be burdened with the potential stigma of colonialism. The United States and the Netherlands in particular do not have a good history with colonialism and a private venture that would create an extraterrestrial colony could be construed as a sovereign claim of territory that may be unpalatable both in the realm of international law and politics.

In addition, the establishment of a Martian colony may have even further reaching legal effects. The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the Moon Treaty) is considered to be a 'failed treaty' due to the low number of states agreeing to be bound by its provisions. One country that has, however ratified is The Netherlands. This makes the precepts of the Moon Treaty legally binding upon a colonization effort by Mars One. Specifically, Article 7(1) dealing with the alteration of the environment and Article 11, which deals with resource development, would be pertinent and enforceable upon the Netherlands. This could be problematic because the United States is not a party to this Agreement. The Netherlands would have to ensure that Mars One was complying with the Moon Treaty, which means that the United States' acceptance of the Netherlands' adherence to the Moon Treaty could be construed as customary acceptance of the Moon Treaty or at the very least the acceptance of an international standard of behavior in harmony with the Moon Treaty. The United States would have to expressly assert its rejection of the Moon Treaty and declare that it

does not intend to be legally bound by customary law through its acquiescence to the Netherlands' performance of its international legal obligations under the Moon Treaty to avoid this issue.

Ticket to Ride? Mars One Project and Launch Licensing

Complicit with the issue of colonialism is the issue of obtaining a launch license. The only practicable way for Mars One to establish a colony on Mars is to perform its activities under the jurisdiction of the United States, which means Mars One would be subject to Title 51, Chapter 509, more commonly known as the Commercial Space Launch Act of 1984, and would be required to obtain a launch license. However, obtaining a launch license is no trivial matter and more so with an endeavor like Mars One. If the United States issued a launch license to Mars One and the Netherlands gave its approval as well, that license would have to potentially cover decades of launch activities to not only start the colony, but also to resupply it and grow it. In other words, to the extent that the commitment of those who journey to Mars will be all in, the governments of the United States and the Netherlands would have to similarly commit all in when and if it grants a license for Mars One to proceed.

Any license granted to Mars One would have to be irrevocable and last in perpetuity because the survival of the colony would be wholly dependent on Mars One to resupply and grow the colony via launches from Earth.²⁰ A license that does not cover for the duration of mission would threaten the colonists' survival; i.e. the possibility that the launch license might be revoked or denied for future launches to support the colony could prove fatal for existing colonists on Mars

because it would bring into question the ability to resupply and populate the colony. This fact alone will cause great hesitation because both governments would be for all practical matters diluting their ability under Article VI of the Outer Space Treaty to terminate the mission while being fully encumbered with the responsibility of its potential failure. In effect, such a license could not be morally revoked and could only expire in the event that the colony failed, at which point both governments could refuse to give their approval for any further adventures by Mars One.

Pertinent to the issuance of a launch license is whether either country is willing to allow such a high-risk venture to proceed. Mars One as currently envisioned has a high probability of failure if not during the transit to Mars then during the initial colonization effort. The political, public and media response to the death of the colonists would be significant, especially if the public witnesses the demise of the colonists on the proposed reality television program. The ensuing firestorm of negative media coverage, the public condemnation, the subsequent political backlash and the inevitable geopolitical soft-power exploitation of the colony's demise will be significant and may very well sour the appetite for future government and/or private colonization efforts. This coupled with the potential national security issues, the international and domestic legal questions, and the geopolitical questions that the colony would raise suggests that Mars One would likely not receive the requisite launch license to not only start the colony but to sustain it as well.

Keep it in the family? Domestic arrangements and Mars One

Another issue that is not brought up during the media excitement surrounding the proposed mission is the domestic/family legal issues that will arise as a result of the colonists permanently leaving to start a new life on another planet. In particular, is the issue of divorce. Many of the 100 selectees are married and have children. This raises the question that if the current and future selectees are married and go to Mars, what becomes of their spouses. In other words, will their spouses continue to be married to the colonists or could they receive a divorce before the colonists leave or otherwise have their marriages annulled.

United States law and the law of the particular state the colonists reside in before they depart would control. A divorce could likely be granted on no-fault grounds, since most jurisdictions in the United States recognize this type of divorce. However, the decision by one spouse to abandon his or family to start a new life and potentially with a new spouse is bound to create a divide and create a contentious divorce on fault grounds even during the preliminary selection process regardless of how the media has extolled the spousal support for the venture among those selectees who are married. However, as the mission draws closer so will the reality that one spouse will be abandoning the other and with it the potential for conflict and the possibility of divorce proceedings on fault grounds. While some selectees may argue that they were going to give their spouse a divorce anyways, state laws concerning divorce may find that the spouse leaving for Mars may be liable for alimony or child support in the case of those selectees who may have minor children.

A court order mandating alimony or child support in one jurisdiction can be enforced in another state, which means that a state court could hold a selectee in contempt of court if he/she is scheduled to leave the planet, which potentially could be seen as disregarding his/her legal obligations under the court-ordered decree of divorce. Unless, the selectee or Mars One creates a trust to pay for alimony and/or child support upon the selectee's departure, a state court could conceivably make an order forbidding the selectee to leave on the mission, which could be enforced by local law enforcement, and even result in confinement. The question then is whether Mars One would be able to take on the financial responsibility of alimony and child support obligations of its colonists and whether a state court would allow it to do so. In the grander scheme of the dream of Mars colonization, the reality of this basic family legal question must be answered along with other legal and political questions that will arise in the course of preparing for the embarkation of the colonists to Mars.

Conclusion

Mars One is an ambitious undertaking and an inspiration to those who wish to see and participate in the expansion of humanity into the solar system. Yet this grand vision and promise of adventure does not negate the reality of the issues that must be recognized and addressed before that vision can be realized. Simply wishing the problems away and assuming that they can be sorted out closer to the time is not the foundation needed for the first human exploration to Mars. Half a century of human space exploration has shown that the devil is in the detail and Mars One ignores that detail at its peril. Unless the reality of the challenges facing Mars One are acknowledged and

addressed by the leaders of this project, the current tide of positive media attention will turn on Mars One and leave those who believed in the vision created by its progenitors disillusioned and detriment future endeavors by private space to develop the solar system.

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² [The Technology](#), Mars One Project, last visited March 9, 2015.

³ http://www.nasa.gov/home/hqnews/2012/mar/HQ_12-090_LAUNCH_Beyond_Waste.htm. See also <http://www.paragonsdc.com>.

⁴ Nancy Atkinson, [The Mars Landing Approach: Getting Large Payloads to the Surface of the Red Planet](#), July 17, 2007.

⁵ National Aeronautics and Space Administration, [Supersonic Retropropulsion Technology Development in NASA's Entry, Descent, and Landing Project](#), Karl Edquist, Scott Berry, Bil Kleb, Ashley Korzun, Artem Dyakonov, Kerry Zarchi, Guy Schauerhamer, Ethan Post.

⁶ Sydney Do, Koki Ho, Samuel Schreiner, Andrew Owens, Olivier de Weck, AN [INDEPENDENT ASSESSMENT OF THE TECHNICAL FEASIBILITY OF THE MARS ONE MISSION PLAN](#), 65th International Astronautical Congress, Toronto, Canada.

⁷ Elizabeth Howell, [Mars One Dustup: Founder Says Mission Won't Fail As MIT Study Predicts](#), October 14, 2015.

⁸ <http://www.purduereview.com/science/the-early-failure-of-mars-one-and-why-it-matters/>

⁹ <http://www.bbc.co.uk/programmes/b03vpc74>

¹⁰ Claude Lafleur, [Costs of US piloted programs](#), The Space Review, March 8, 2010

¹¹ John Putman, [Mars One, the “Third Quarter Effect”, and our human journey into deep space](#), The Space Review, January 26, 2015.

¹² Chris Chambers, [Mars One: The psychology of isolation, confinement and 24-hour Big Brother](#), The Guardian, September 9, 2013.

¹³ Irene Klotz, [Mars Crew Guinea Pigs Suffered Insomnia, Lethargy](#), January 16, 2013.

¹⁴ [Will psychological issues become a problem for the astronauts?](#), Mars One, last visited March 9, 2015.

¹⁵ Irene Klotz, [Mars Crew Guinea Pigs Suffered Insomnia, Lethargy](#), January 16, 2013.

¹⁶ James Kingland, [Bas Lansdorp Q&A: 'I hope to go to Mars myself one day'](#), The Guardian, December 10, 2013.

¹⁷ [U. S. v. The Nancy](#), 3 Wash. C. C. 287, Fed. Cas. No. 15,854.

¹⁸ Whether Mars One could successfully incorporate as a non-profit organization in the United States is debatable. Non-profit organizations in the United States are heavily scrutinized by the federal and state governments, and it's unclear whether the innocuous goals of Mars One could withstand the substantial regulatory scrutiny.

¹⁹ A common straw man argument from private space advocates is that jurisdiction under Article VI could be avoided if the private entity expatriates itself to a non-OST country such as Tonga and performs its activities from there. This approach is fundamentally flawed because even if the organization expatriates itself, Article VI could still reach to the individuals of the organization and follow them to the non-OST country. Beyond that, expatriation of a private entity to a non-OST country would also cut off resources vital to not only launch the precursor missions for Mars One, but also the high-rate of supply and support needed not to mention further missions to grow the colony.

²⁰ It's plausible that a launch license could be revoked; however, that would mean that the United States and the Netherlands, who both have continuing jurisdiction and responsibility over the Mars One and the colonists per Article VI of the OST, would be responsible for ensuring the colony survives, which means that resupply launches would have to be coordinated and paid for by the respective governments. Because of this possibility, Mars One would have to be under constant oversight and heavily scrutinized to ensure that it will not fail and meet its obligations to support the colony. This level of oversight will draw the ire of the purist approach to private space activities, but it is unavoidable.